Analysis of head supported mass effects on soldiers during a simulated urban assault

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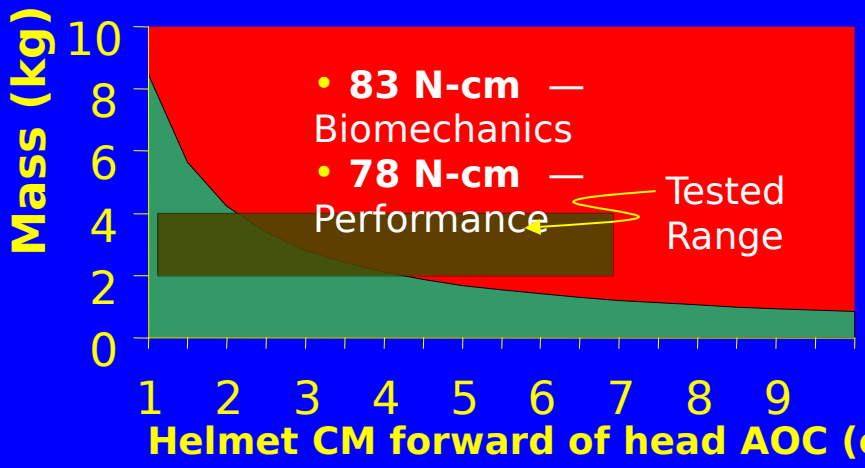
Head - Supported Mass

USAARL/DRDC Cooperation

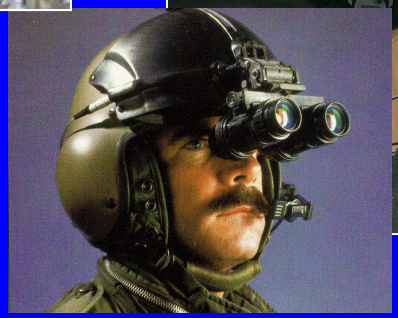


What we know about HSM

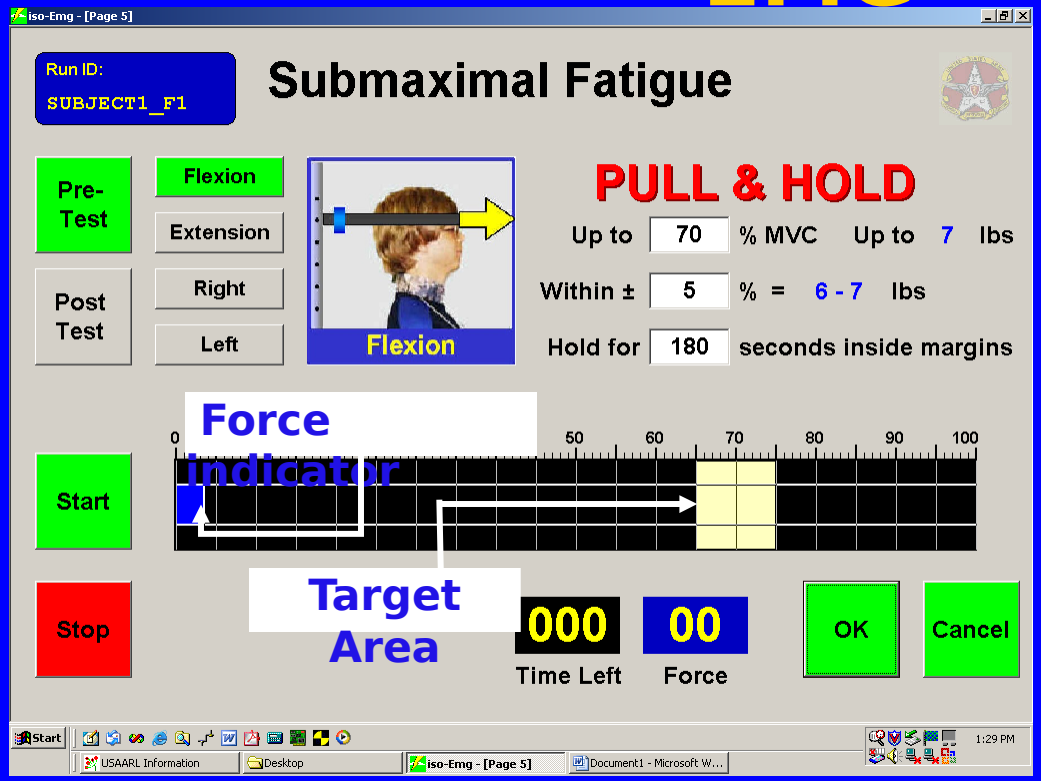
- Heavier HSM use is widespread in the military
- Guidelines do not address future combat system and operational environments
- Added **HSM degrades soldier performance**
- Added **[illegible] injuri**

HSM: Warfighter Health & Performance

- **USAARL**: Helmet loads and configurations in a UH60 Simulator (completed)
- **DRDC**: Helmet loads on ground soldiers during Mobile Operations in Urban Terrain exercises (ongoing)
- Common questions and desired information
  - USAARL offered to analyze data collected by DRDC



Measuring fatigue with EMG



Fatigue testing

- Follows max effort and calibration recordings
- Subject pulls and holds (until fatigued)
- Conducted PRE and POST exposure

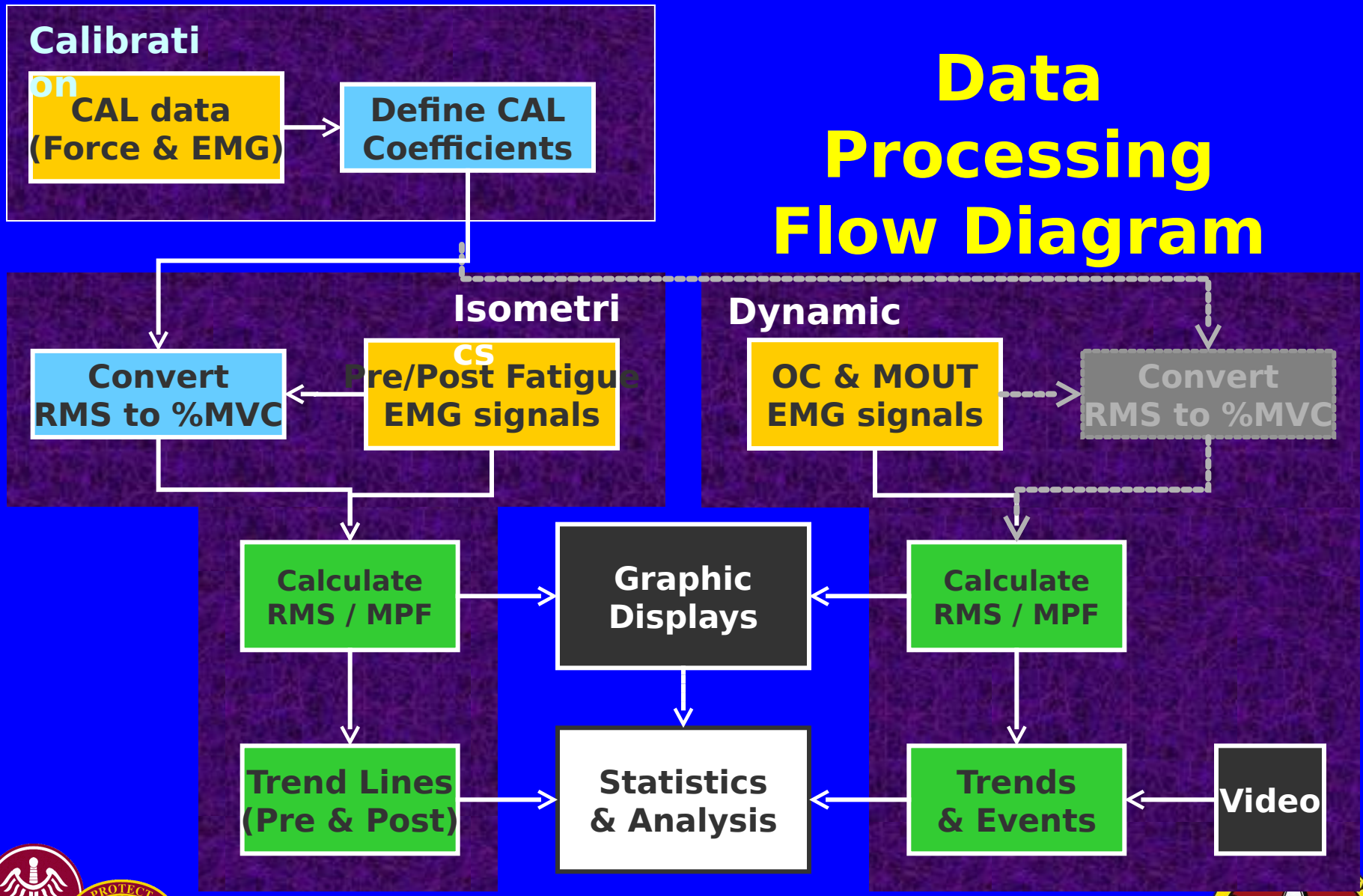
- Subject quits
- Outside window
- Time out

Exposure conditions (4 x 2)

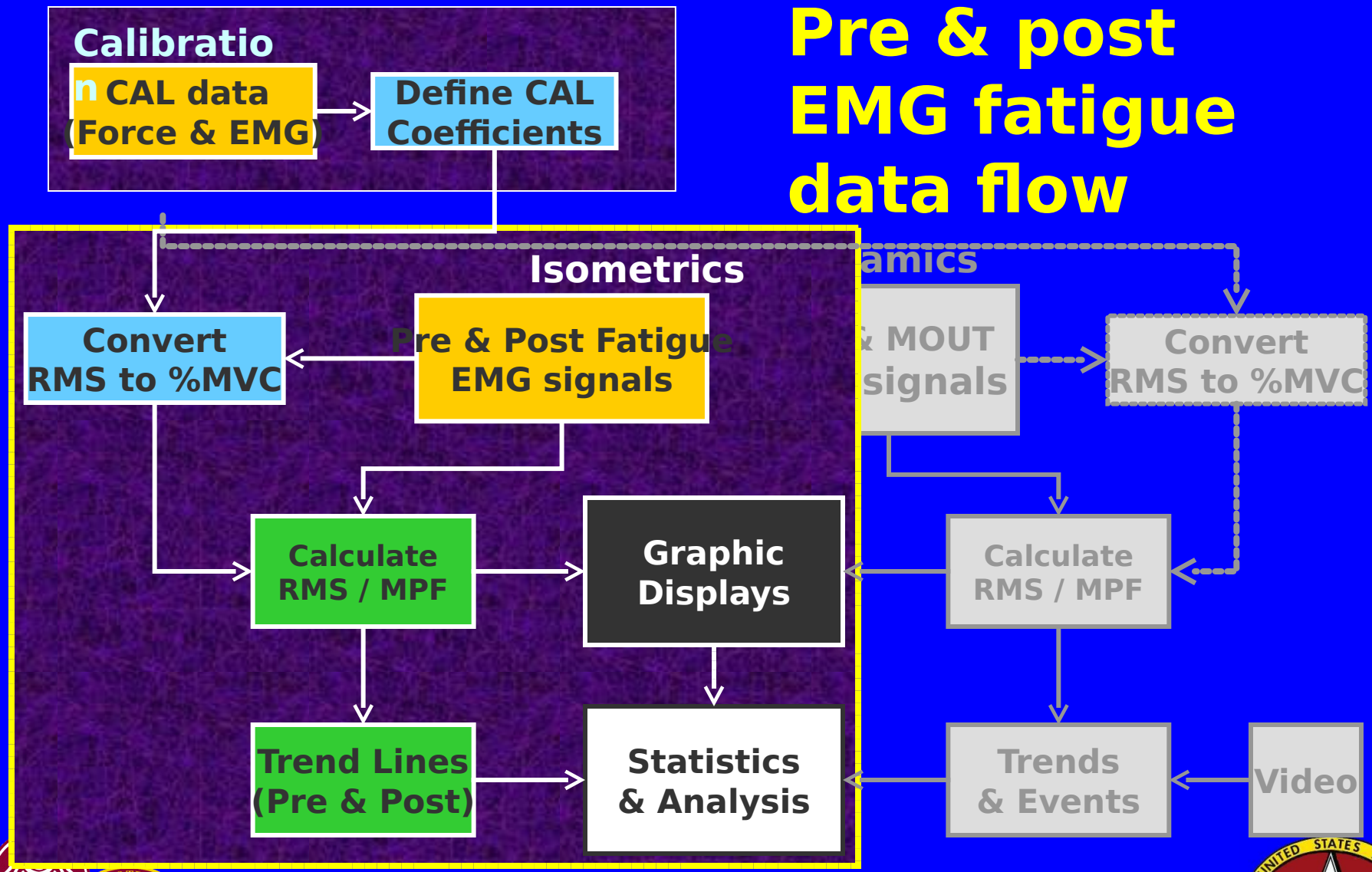
EMG Video Accel

EMG Video Accel

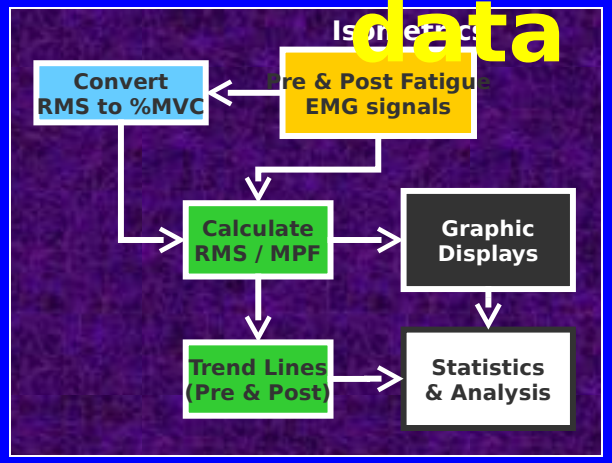
Data Processing Flow Diagram



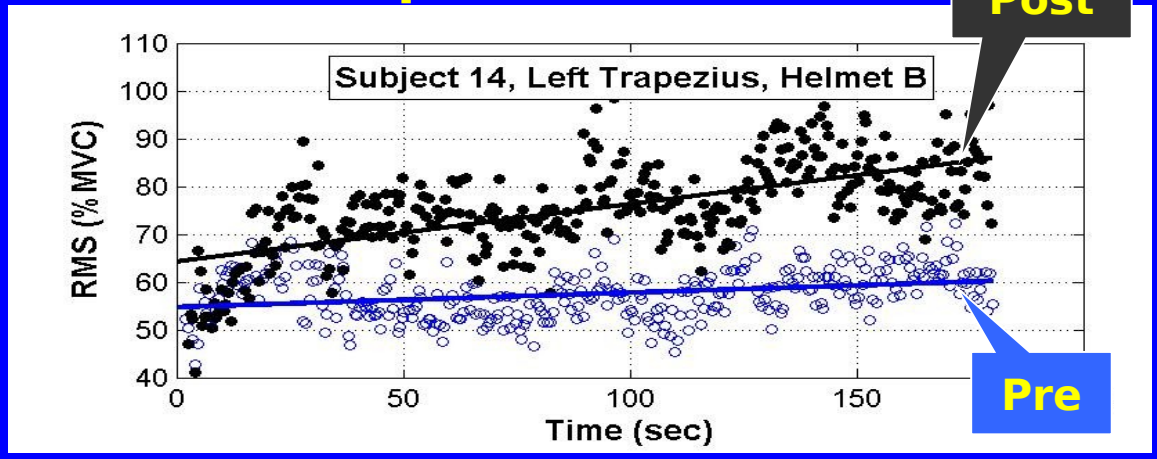
Pre & post EMG fatigue data flow



Pre & post EMG fatigue data

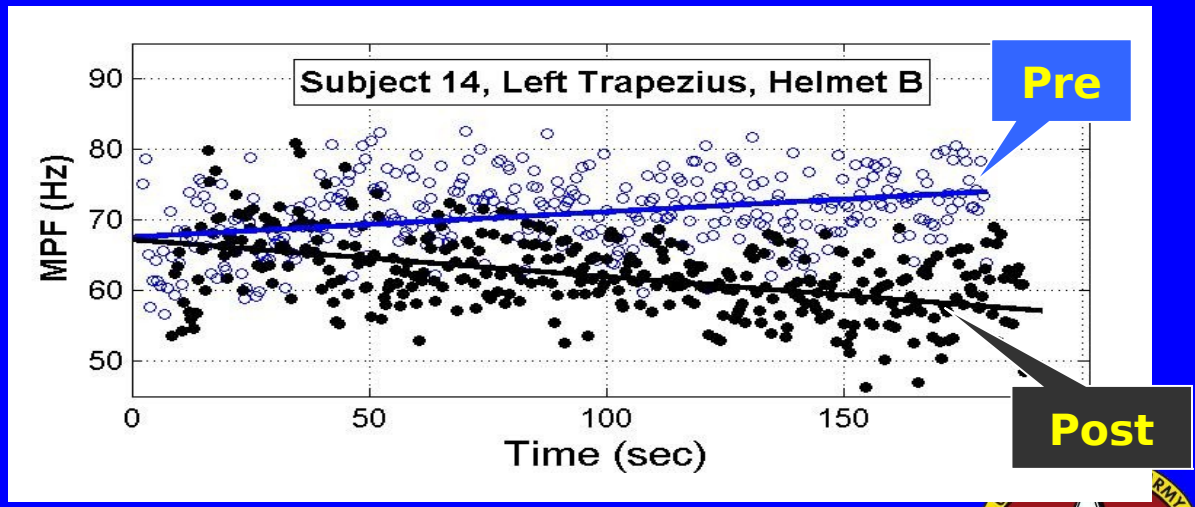

Convert RMS to %MVC
Pre & Post Fatigue EMG signals
Calculate RMS / MPF
Graphic Displays
Trend Lines (Pre & Post)
Statistics & Analysis

Pre- and Post exposure Sample isometric EMG

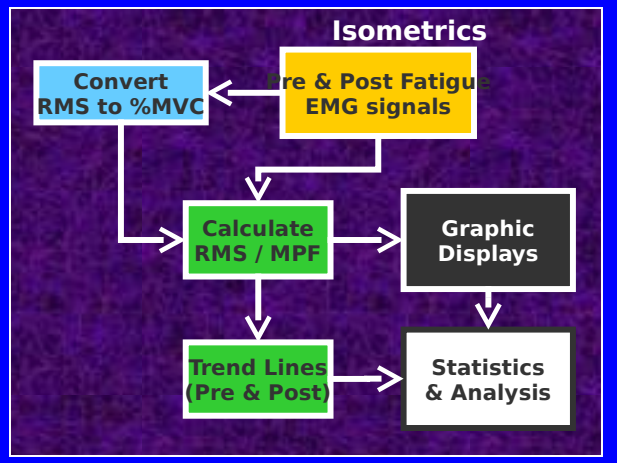


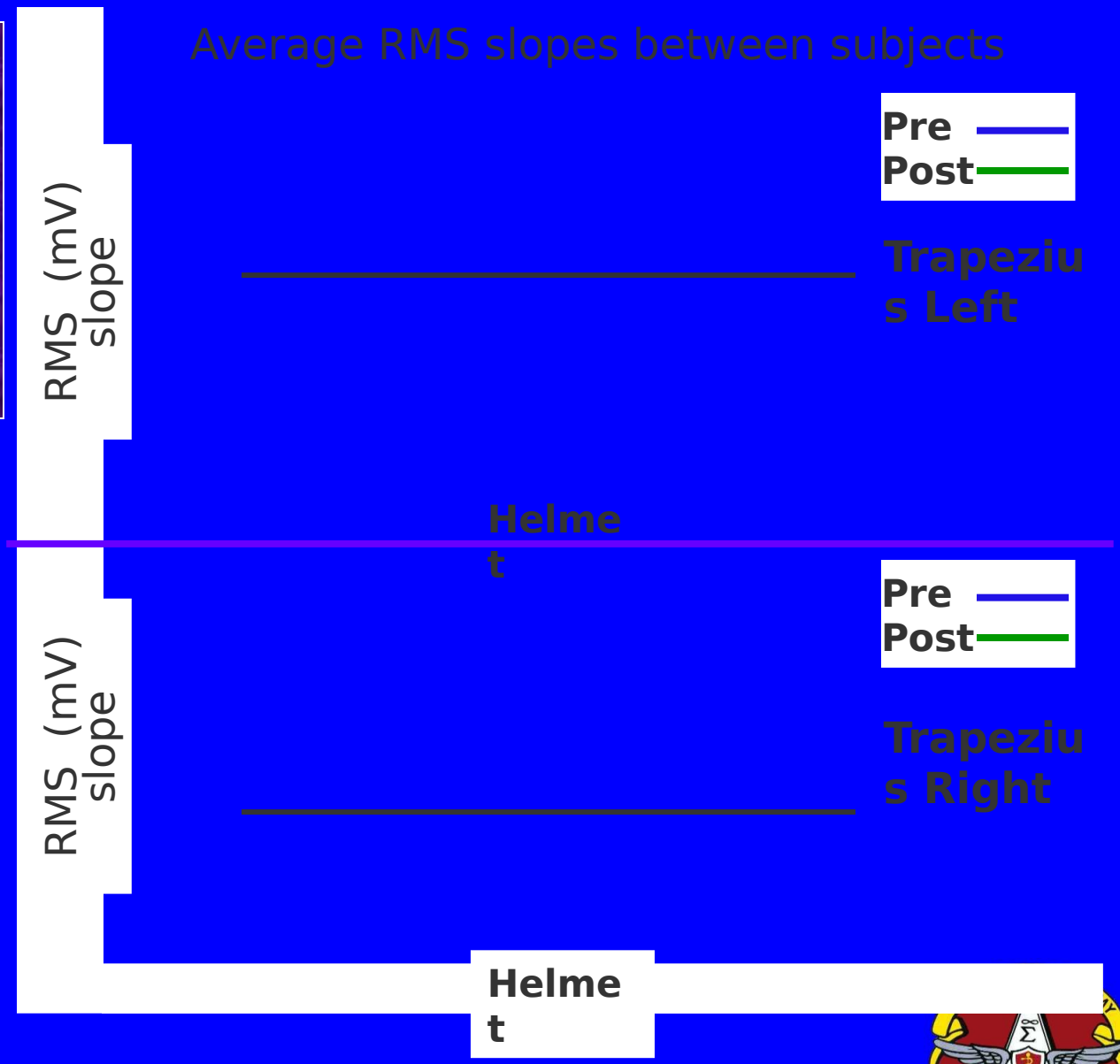
Fatigue indicated by:

- **Increase of RMS** (slope > 0)
- **Decrease of MPF** (Slope < 0)



Preliminary Results: Flexion RMS

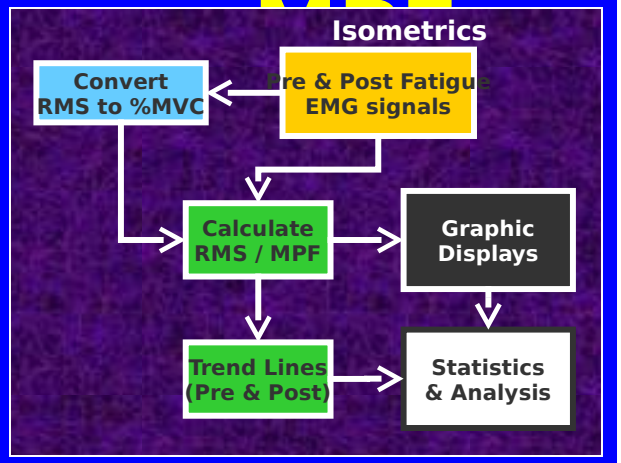


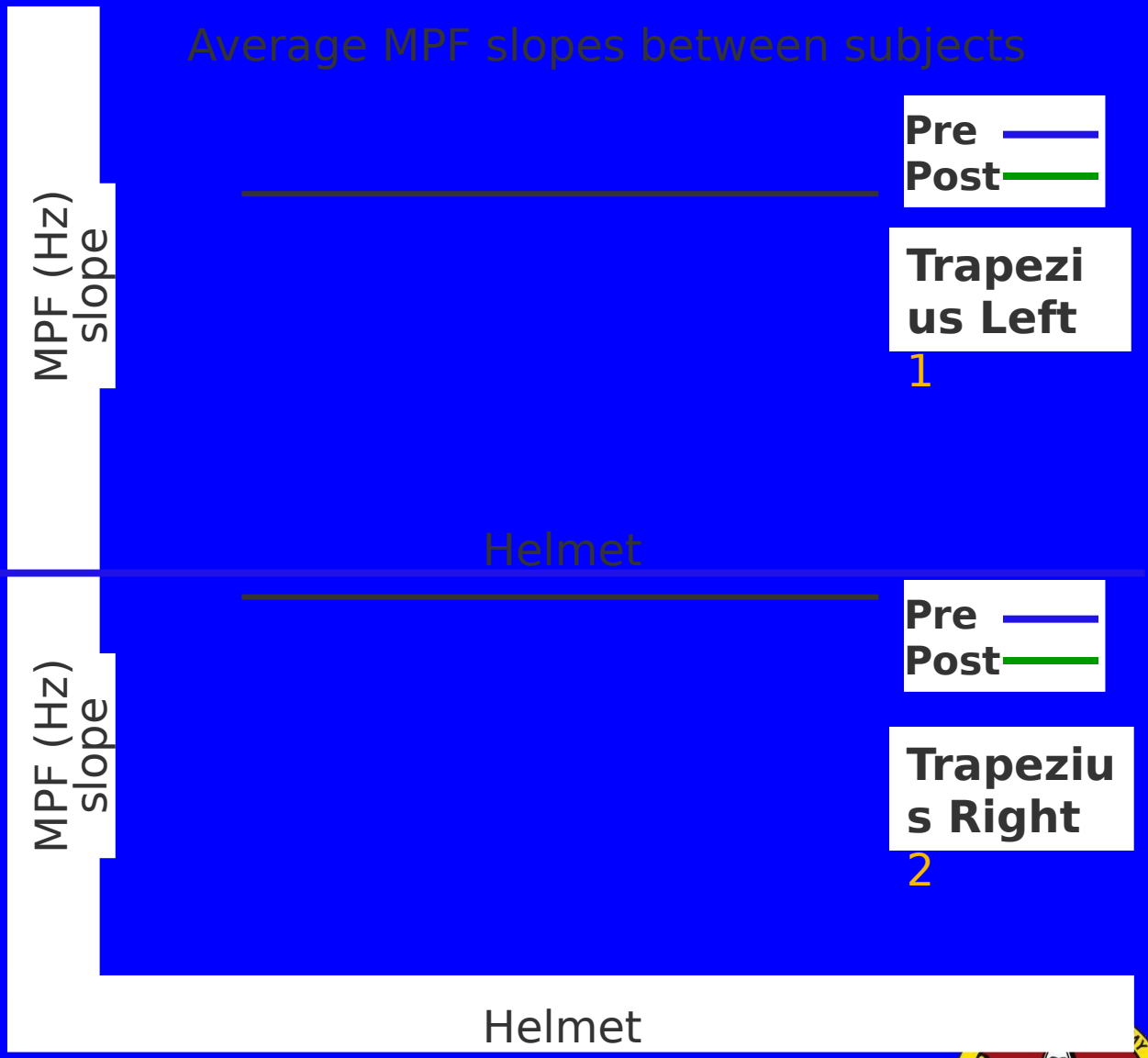


Fatigue indicated by:

- **Increase of RMS** (slope > 0)

Preliminary Results: Flexion MPF

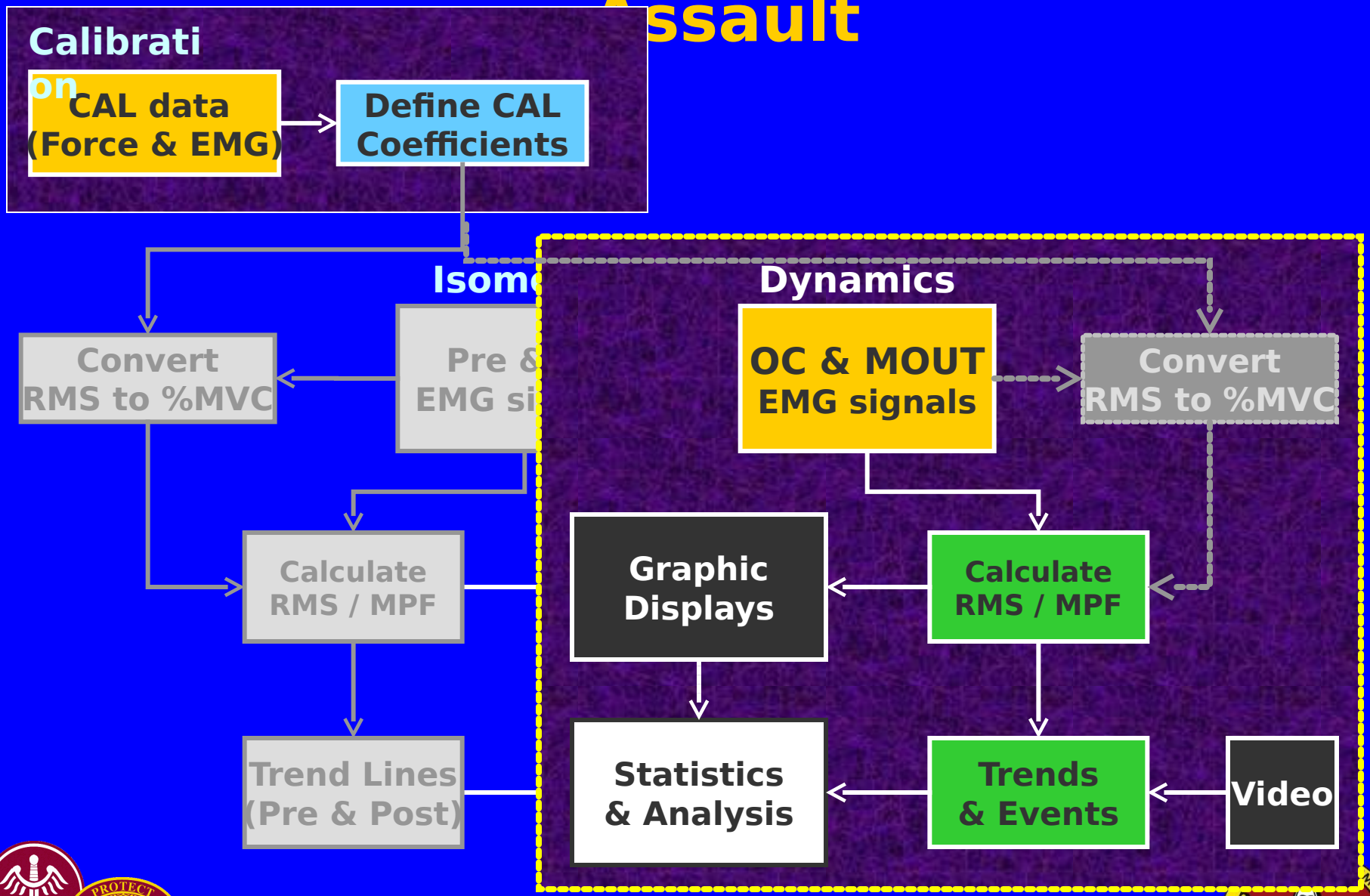




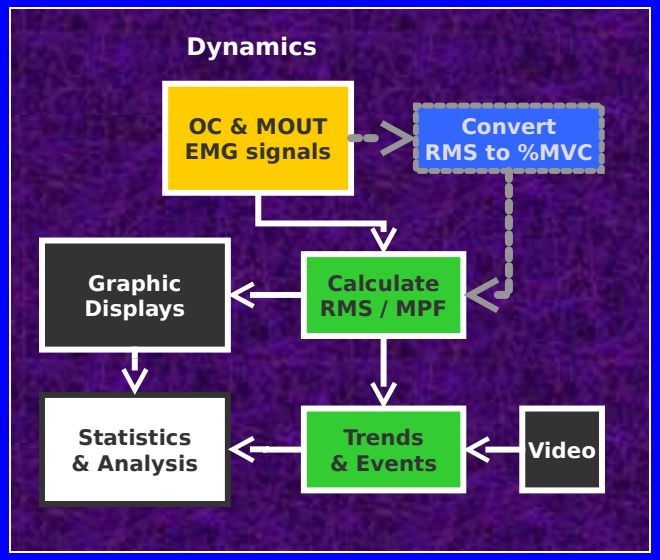
Fatigue indicated by:

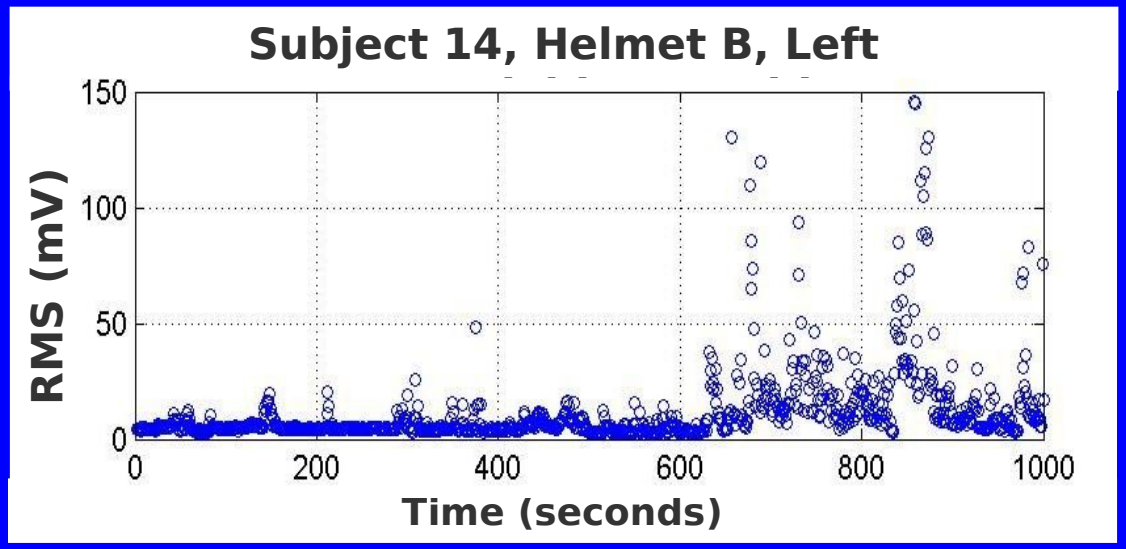
- **negative MPF slopes**
- **Sharper negative slope implies subject fatigued faster**

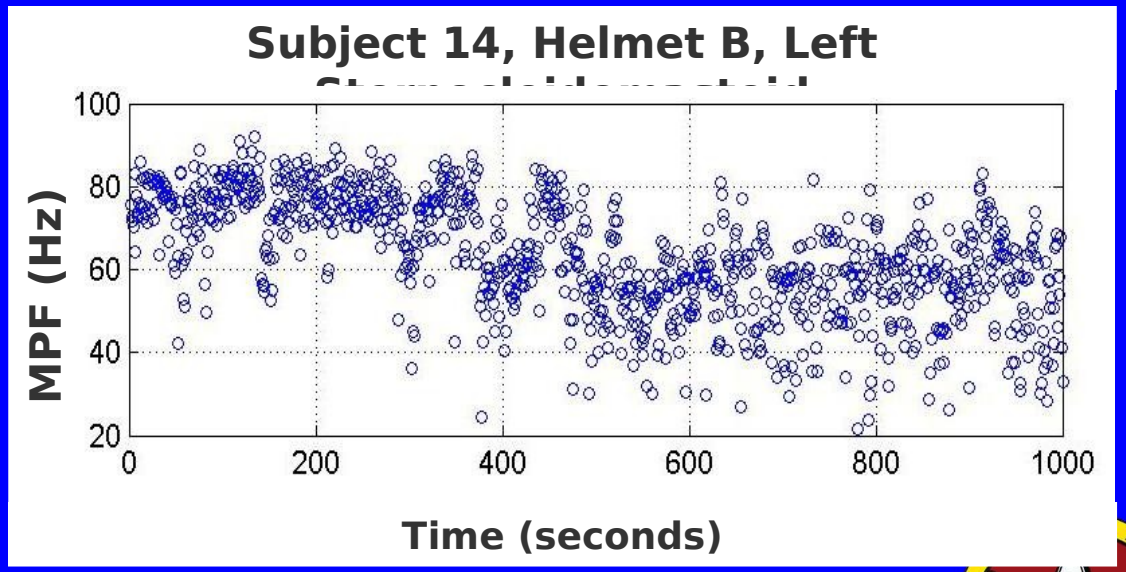
Obstacle Course & MOUT Assault



Obstacle Course

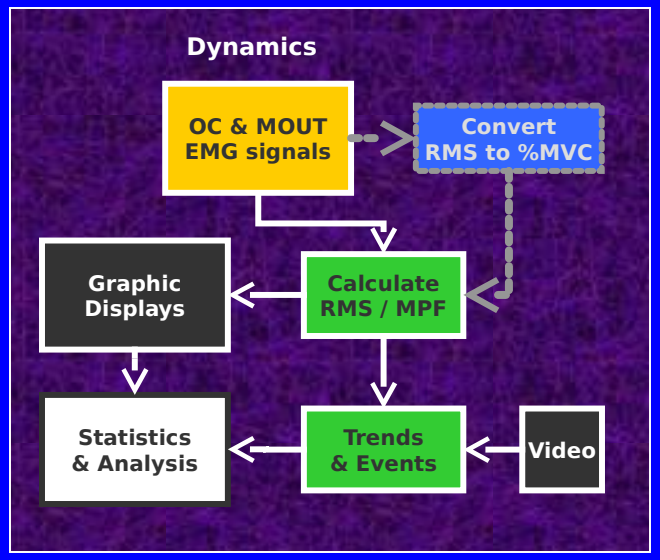


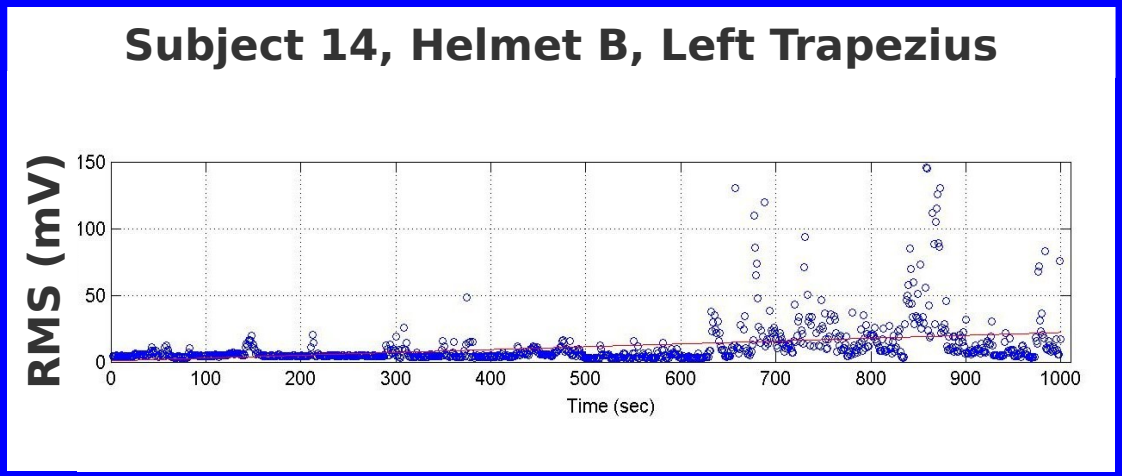


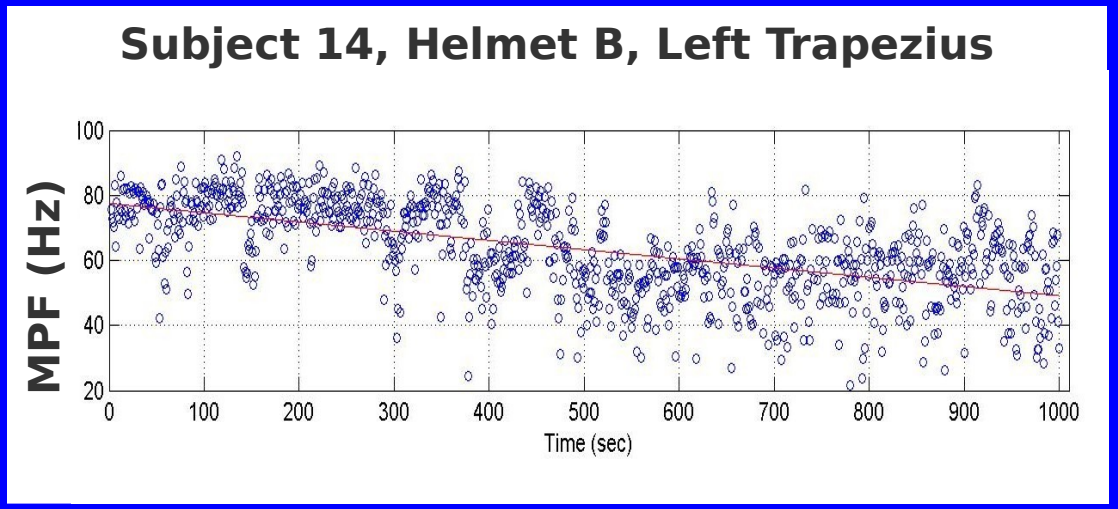


- More suited to discrete analyses
- Need to identify trends & events (from video)

MOUT assault







- Longer term activity
- Peaks in RMS, general negative slope in MPF

Issues affecting statistics & analysis

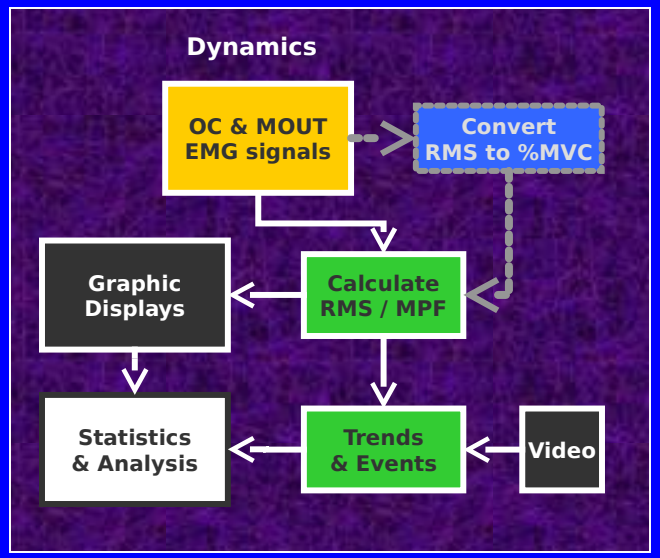
Obstacle Course

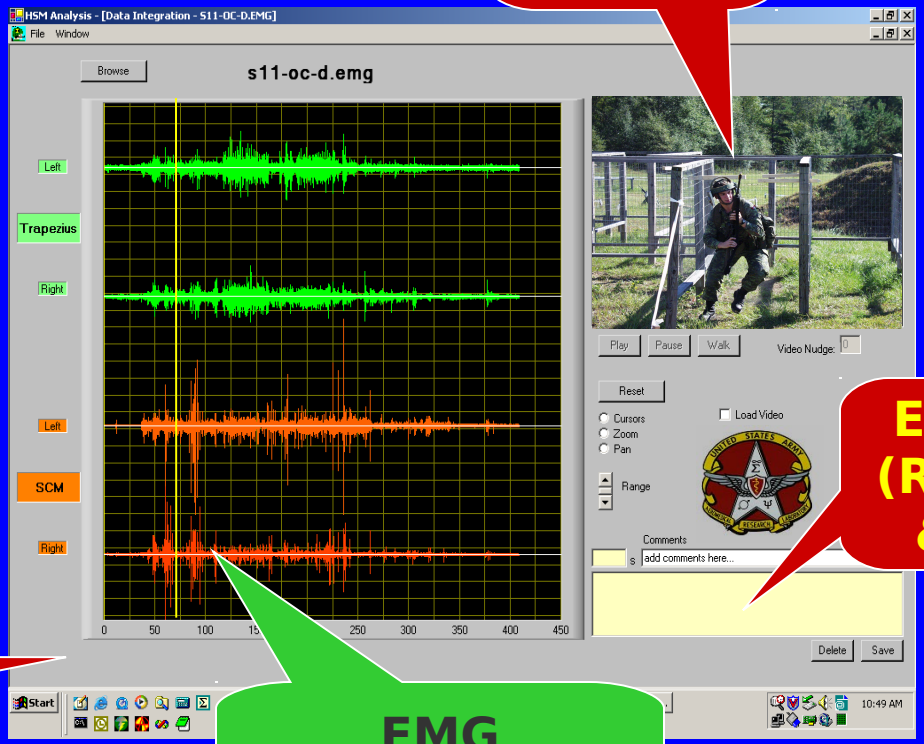
- Pre/post measures during obstacle course were done only after exposure to all four helmets, not allowing differences between helmets
  - Portable equipment?

MOUT assault

- Only four subjects for MOUT assault pre/post comparison
  - Sound techniques, but low statistical power
- Difficult to get video to synchronize EMG and events
  - Use MOUT cameras?

Integration of DRDC EMG Data





Video

Events (Review & ID)

Events timeline

EMG Recordings

- Build upon methods used in NUH-60FS study

Summary & Conclusions

- Common programs brought together complementary needs and capabilities of DRCD and USAARL
- Cooperation between DRDC and USAARL allowed the provision of:
  - Equipment to gather pre/post fatigue data within the DRDC protocol
  - Procedures proven at USAARL into the DRDC protocol
- Circumstances adversely affected the statistical power of the pre/post fatigue analyses
- Dynamic EMG data and video is currently being integrated and processed

- A solid framework of cooperation exists between DRDC and USAARL in materials and methods to analyze the effects of head-supported mass on infantry soldiers

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